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# FSA201 — USB2.0 Full-Speed and Audio Switches with Negative Signal Capability

## Features

- 3Ω Typical ON Resistance
- -3db Bandwidth: > 250MHz
- Low Power Consumption
- Packaged in Pb-free 10-pin MSOP and 10-Lead MicroPak™ (1.6 x 2.1mm)
- Power-off Protection on Common D+/R, D-/L Ports
- Automatically Detects  $V_{BUS}$  for Switch Path Selection

## Applications

- Cell Phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

## Description

The FSA201 is a Double-Pole, Double Throw (DPDT) multiplexer that combines a low-distortion audio and a USB2.0 Full-Speed (FS) switch path. This configuration enables audio and USB data to share a common connector port. The architecture is designed to allow audio signals to swing below ground. This means a common USB and headphone jack can be used for personal media players and similar portable peripheral devices.

Since USB2.0 is an industry standard for shared data-path in portable devices, the FSA201 also incorporates a  $V_{BUS}$  detection capability. The FSA201 includes a power-off feature to minimize current consumption when  $V_{BUS}$  is not present. This power-off circuitry is available for the common D+/R, D-/L ports only. Typical applications involve switching in portables and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers.

## Ordering Information

Part Number	Package Number	Packing Description
FSA201L10X	MAC010A	10-Lead MicroPak, JEDEC MO-255, 1.6 x 2.1mm
FSA201MUX	MUA10A	10-Lead MSOP, JEDEC MO-187, 3.0mm Wide

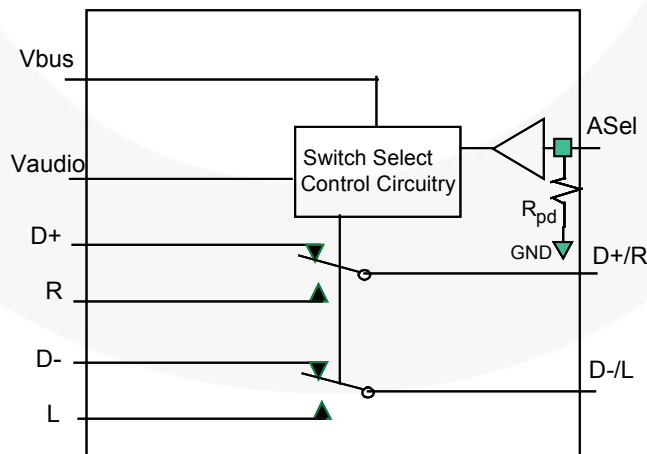


Figure 1. FSA201 Analog Symbol

## Pin Assignments

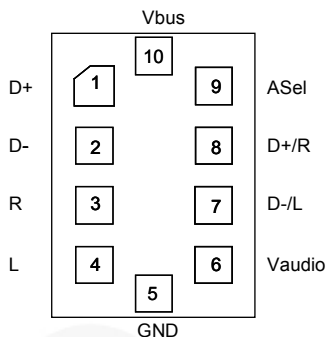


Figure 2. MicroPak™ 10-Pin

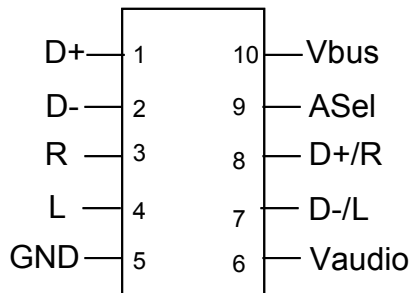


Figure 3. MSOP 10-Pin

## Pin Descriptions

Pin #	Name	Description
1, 2	D+, D-	USB data bus input sources
6	V <sub>AUDIO</sub>	Power supply (audio)
3, 4	R, L	Audio right and left input sources
9	A <sub>SEL</sub>	Audio select to override auto USB detect when V <sub>AUDIO</sub> supply is present
10	V <sub>BUS</sub>	Power supply (USB) and auto USB switch-path select
8, 7	D+/R, D-/L	USB and audio common connector ports

## Truth Table

A <sub>SEL</sub> <sup>(1)</sup>	V <sub>AUDIO</sub>	V <sub>BUS</sub>	L, R	D+, D-
LOW	LOW	LOW	OFF	OFF
LOW	LOW	High <sup>(2)</sup>	OFF	ON
LOW	HIGH <sup>(2)</sup>	LOW	ON	OFF
LOW	HIGH <sup>(2)</sup>	HIGH <sup>(2)</sup>	OFF	ON
HIGH	LOW	LOW	OFF	OFF
HIGH	LOW	HIGH <sup>(2)</sup>	OFF	ON
HIGH	HIGH <sup>(2)</sup>	LOW	ON	OFF
HIGH	HIGH <sup>(2)</sup>	HIGH <sup>(2)</sup>	ON	OFF

### Notes:

1. A<sub>SEL</sub>- Internal resistor to GND provides auto-V<sub>BUS</sub> detect if there is no external connection. Forcing A<sub>SEL</sub> HIGH when V<sub>AUDIO</sub> is present overrides the USB path even if V<sub>BUS</sub> is present.
2. H - Value is the threshold as defined to meet USB2.0 V<sub>BUS</sub> requirements and audio supply threshold in a system (see DC Tables).

## Functional Description

The FSA201 is a combined USB and audio switch that enables sharing the D+/D- lines of a USB connector with stereo audio CODEC outputs. The switch is optimized for full-speed USB signals and includes an automatic  $V_{BUS}$ -detection circuit. When a USB connector, rather than a headphone, is connected to the ultra-portable device the switch is automatically configured for full-speed USB data transfer. If no  $V_{BUS}$  is detected, and yet  $V_{AUDIO}$  is present, the switch is configured for the low-distortion audio switch path. The audio switch path also handles negative signals (down to  $-2V$ ), which eliminates the need for large coupling capacitors.

For those applications where the  $V_{BUS}$  is generated as a self-powered device or where  $V_{BUS}$  is not removed, the  $A_{SEL}$  pin provides the ability to switch, under software

control, to the audio path. The  $A_{SEL}$  pin is internally terminated by a resistor to GND (typical value  $3M\Omega$ ) and requires no connection for the standard ultra-portable (cell-phone, MP3, or Portable Media Player). In an application where the supply to the FSA201  $V_{BUS}$  pin is not guaranteed to be removed, a GPIO pin can be used to switch out of full-speed USB mode into audio mode, using the  $A_{SEL}$  pin.

The FSA201  $V_{BUS}$  pin must be connected directly to  $V_{BUS}$  or a supply  $> 3.8V$ , not an LDO regulated down to  $3.6V$  or a  $V_{bat}$ -generated supply that may fall below  $3.8V$  in normal operation (see the Application Diagram).

## Application Diagram

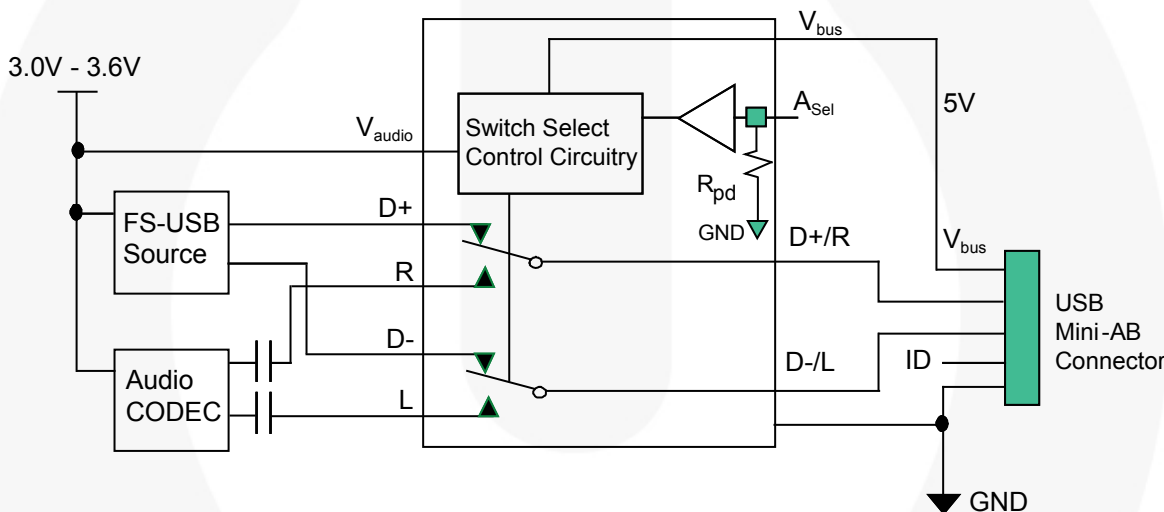


Figure 4. Application Diagram

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
$V_{\text{AUDIO}} / V_{\text{BUS}}$	Supply Voltage		-0.5	6.0	V
$V_{\text{SW}}$	Switch I/O Voltage <sup>(3)</sup>	D+, D-, D+/R, D-/L Pins	$V_{\text{BUS}} - 7.0$	$V_{\text{BUS}} + 0.3$	V
		R, L, Pins	$V_{\text{AUDIO}} - 7.0$	$V_{\text{AUDIO}} - 0.3$	V
$A_{\text{SEL}}$	Control Input Voltage		-0.5	6.0	V
$I_{\text{IK}}$	Input Clamp Diode Current		-50		mA
$I_{\text{SW}}$	Switch I/O Current (Continuous)	USB		50	mA
		Audio		250	
$I_{\text{SWPEAK}}$	Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle)	USB		100	mA
		Audio		500	
$T_{\text{STG}}$	Storage Temperature Range		-65	+150	°C
$T_{\text{J}}$	Maximum Junction Temperature			+150	°C
$T_{\text{L}}$	Lead Temperature (Soldering, 10 seconds)			+260	°C
ESD	Human Body Model (JEDEC: JESD22-A114)	I/O to GND		10	kV
		All Other Pins		8	
	Charged Discharge Model (JEDEC: JESD22-C101)				

### Note:

- The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter		Minimum	Maximum
$V_{\text{AUDIO}}$	Supply Voltage		2.7V	3.6V
$V_{\text{BUS}}$	Supply Voltage		4.25V	5.50V
$A_{\text{SEL}}$	Control Input Voltage		0V	$V_{\text{AUDIO}}$
$V_{\text{SW}}$	Switch I/O Voltage		$V_{\text{AUDIO}} - 6.5V$	$V_{\text{AUDIO}} - 0.3V$
$T_{\text{A}}$	Operating Temperature		-40°C	85°C
$\theta_{\text{JA}}$	Thermal Resistance (free air)	MicroPak 10		330°C / W (estimated)

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	V <sub>AUDIO</sub> (V)	Condition	T <sub>A</sub> =- 40°C to +85°C			Unit
				Min.	Typ.	Max.	
<b>Common Pins</b>							
V <sub>IK</sub>	Clamp Diode Voltage	2.7	I <sub>IK</sub> =-18mA			-1.2	V
V <sub>IH</sub>	Control Input Voltage HIGH	2.7 to 3.6		1.3			
V <sub>IL</sub>	Control Input Voltage LOW	2.7 to 3.6				0.5	
I <sub>IN</sub>	A <sub>SEL</sub> Input HIGH Current	3.6	V <sub>CNTRL</sub> =0V to 3.6V	-3		3	μA
I <sub>OFF</sub>	Power Off Leakage Current (Common Port Only D+/R, D-/L)	V <sub>AUDIO</sub> = V <sub>BUS</sub> =0V	Common Port (D+/R, D-/L) V <sub>SW</sub> =0V to 5.5V			1	μA
I <sub>NO(OFF)</sub>	Off Leakage Current of Port D+, D-, R, L	3.6	V <sub>BUS</sub> =0V, 5.5V D+/R, D-/L=0.3V, V <sub>AUDIO</sub> - 0.3V D+, D-, R, L=0.3V, V <sub>AUDIO</sub> - 0.3V or Floating Figure 14	-50	10	50	nA
I <sub>NC(ON)</sub>	On Leakage Current of Port D+/R or D-/L	3.6	V <sub>BUS</sub> =0V, 5.5V D+/R, D-/L=0.3V, V <sub>AUDIO</sub> - 0.3V, D+, D-, R, L=Floating Figure 15	-100	50	100	nA
<b>USB Switch Path</b>		V <sub>BUS</sub> (V)					
	USB Analog Signal Range			0		3.6	V
R <sub>ONUSB</sub>	FS Switch On Resistance <sup>(4)</sup>	4.25	V <sub>D+/D-</sub> =0V, 3.0V, I <sub>ON</sub> =-8mA Figure 6, Figure 13		3	6	Ω
Δ R <sub>ONUSB</sub>	FS Delta R <sub>ON</sub> <sup>(4,6)</sup>	4.25	V <sub>D+/D-</sub> =3V, I <sub>ON</sub> =-8mA		0.35		Ω
<b>Audio Switch Path</b>		V <sub>AUDIO</sub> (V)					
	Audio Analog Signal Range			V <sub>AUDIO</sub> - 6.5		V <sub>AUDIO</sub>	V
R <sub>ONAUDIO</sub>	Audio Switch On Resistance <sup>(7)</sup>	2.7	V <sub>L/R</sub> =-2V, 0V, 0.7V, V <sub>AUDIO</sub> -0.7V, V <sub>AUDIO</sub> I <sub>ON</sub> =-100mA, V <sub>BUS</sub> =0V Figure 5, Figure 13		0.5	1.0	Ω
Δ R <sub>ONAudio</sub>	Audio Delta R <sub>ON</sub> <sup>(4)</sup>	2.7	V <sub>L/R</sub> =0.7V I <sub>ON</sub> =-100mA		0.01	0.10	Ω
R <sub>FLAT(Audio)</sub>	Audio R <sub>ON</sub> Flatness <sup>(5)</sup>	2.7	V <sub>L/R</sub> =-2V, 0V, 0.7V, 2V, 2.7V I <sub>ON</sub> =-100mA			0.35	Ω

### Notes:

4. ΔR<sub>ON</sub>=R<sub>ON max</sub> - R<sub>ON min</sub> measured at identical V<sub>CC</sub>, temperature, and voltage. Worst-case signal path, audio or USB channel, is characterized.
5. Flatness is defined as the difference between the maximum and minimum values of on resistance over the specified range of conditions.
6. Guaranteed by characterization, not production tested.
7. On resistance is determined by the voltage drop between the A and B pins at the indicated current through the switch.

**DC Electrical Characteristics** (Continued)

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	V <sub>AUDIO</sub> (V)	Condition	T <sub>A</sub> =- 40°C to +85°C			Unit
				Min.	Typ.	Max.	
<b>Power Supply</b>							
V <sub>busth</sub>	V <sub>BUS</sub> Threshold Voltage			3.2		3.8	V
V <sub>audioth</sub>	V <sub>AUDIO</sub> Threshold			0.5		1.5	V
I <sub>CC(Audio)</sub>	Quiescent Supply Current (Audio)	3.0	V <sub>ASEL</sub> =0 to V <sub>AUDIO</sub> , I <sub>OUT</sub> =0			10	μA
I <sub>CC(VBUS)</sub>	Quiescent Supply Current (V <sub>BUS</sub> )		V <sub>ASEL</sub> =0 to V <sub>AUDIO</sub> , I <sub>OUT</sub> =0 V <sub>BUS</sub> =5.5V			20	μA
I <sub>CCT</sub>	Increase in I <sub>CC</sub> Current per Control Voltage and V <sub>CC</sub>	3.0	V <sub>ASEL</sub> =2.6V, V <sub>BUS</sub> =Floating			15	μA
			V <sub>ASEL</sub> =1.8V, V <sub>BUS</sub> =Floating			18	

## AC Electrical Characteristics

All typical value are for  $V_{\text{AUDIO}}=3.3\text{V}$  and  $V_{\text{BUS}}=5.0$  at  $25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	$V_{\text{AUDIO}}/V_{\text{BUS}}$ (V)	Condition	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
$t_{\text{ONAUDIO1}}$	Turn-On Time $V_{\text{AUDIO}}\uparrow$ to Output	$V_{\text{BUS}} = 0\text{V}$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 18			10	$\mu\text{s}$
$t_{\text{OFFAUDIO1}}$	Turn-Off Time $V_{\text{BUS}}\uparrow$ to Output	$V_{\text{AUDIO}}=2.7$ for $V_{\text{BUS}}\uparrow$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 18			10	$\mu\text{s}$
$t_{\text{ONAUDIO2}}$	Turn-On Time $A_{\text{SEL}}$ to Output	$V_{\text{BUS}}=4.25\text{V}$ $V_{\text{AUDIO}}=2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 17			1	$\mu\text{s}$
$t_{\text{OFFAUDIO2}}$	Turn-Off Time $A_{\text{SEL}}$ to Output	$V_{\text{BUS}} = 4.25\text{V}$ $V_{\text{AUDIO}}=2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 18			1	$\mu\text{s}$
$t_{\text{ONAUDIO3}}$	Turn-On Time $V_{\text{BUS}}\downarrow$ to Output	$V_{\text{AUDIO}}=2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 17			10	$\mu\text{s}$
$t_{\text{ONUSB}}$	Turn-On Time $V_{\text{USB}}\uparrow$ to Output	$V_{\text{AUDIO}} = 2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 18			10	$\mu\text{s}$
$t_{\text{OFFUSB}}$	Turn-Off Time $V_{\text{USB}}\downarrow$ to Output	$V_{\text{AUDIO}}=2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}}=1.0\text{V}$ $R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 16, Figure 18			10	$\mu\text{s}$
$t_{\text{PUSB}}$	USB Switch Propagation Delay <sup>(8)</sup>	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$R_{\text{L}}=50\Omega, C_{\text{L}}=50\text{pF}$ Figure 19		0.25		ns
OIRR <sub>USB</sub>	Off-Isolation - USB	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}, R_{\text{T}}=50\Omega,$ $C_{\text{L}}=0\text{pF}$ Figure 8, Figure 23		-55		dB
OIRR <sub>A</sub>	Off-Isolation - Audio	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}, R_{\text{T}}=50\Omega,$ $C_{\text{L}}=0\text{pF}$ Figure 7, Figure 23		-37		dB
Xtalk <sub>USB</sub>	Non-Adjacent Channel Crosstalk - USB	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}, R_{\text{T}}=50\Omega, C_{\text{L}}=0\text{pF}$ Figure 10, Figure 24		-49		dB
Xtalk <sub>A</sub>	Non-Adjacent Channel Crosstalk - Audio	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}, R_{\text{T}}=50\Omega, C_{\text{L}}=0\text{pF}$ Figure 9, Figure 24		-39		dB
BW	-3db Bandwidth	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$R_{\text{T}}=50\Omega, C_{\text{L}}=0\text{pF},$ Signal 0dBm Figure 11, Figure 12, Figure 22		400		MHz
THD	Total Harmonic Distortion	$V_{\text{AUDIO}}=2.7$ $V_{\text{BUS}}=0\text{V}$	$f=20\text{Hz}$ to $20\text{kHz},$ $R_{\text{L}}=32\Omega, V_{\text{R,L}}=2V_{\text{pp}}$ Figure 27		0.05		%
PSRR	Power Supply Rejection Ratio	$V_{\text{AUDIO}}=3.3$ $V_{\text{BUS}}=0\text{V}$	$f=217\text{Hz}$ on $V_{\text{AUDIO}}$ $V_{\text{R,L}}=1.0\text{V}, R_{\text{T}}=32\Omega,$ $V_{\text{Ripple}}=600\text{mV}_{\text{pp}}$		-56		dB

**Note:**

8. Guaranteed by characterization, not production tested.



## USB Full-Speed Related AC Electrical Characteristics

Symbol	Parameter	V <sub>AUDIO</sub> / V <sub>BUS</sub> (V)	Condition	T <sub>A</sub> =-40°C to +85°C			Unit
				Min.	Typ.	Max.	
t <sub>SK(O)</sub>	Channel-to-Channel Skew <sup>(9)</sup>	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V	t <sub>R</sub> =t <sub>F</sub> =12ns (10-90%) at 6MHz C <sub>L</sub> =50pF, R <sub>L</sub> =50Ω Figure 20, Figure 21		150		ps
t <sub>SK(P)</sub>	Skew of Opposite Transitions of the Same Output <sup>(9)</sup>	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V	t <sub>R</sub> =t <sub>F</sub> =12ns (10-90%) at 6MHz C <sub>L</sub> =50pF, R <sub>L</sub> =50Ω Figure 20, Figure 21		150		ps
t <sub>J</sub>	Total Jitter <sup>(9)</sup>	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V	R <sub>L</sub> =50Ω, C <sub>L</sub> =50pF, t <sub>R</sub> =t <sub>F</sub> =12ns (10-90%) at 12Mbps (PRBS=2 <sup>15</sup> - 1)		1.6		ns

**Note:**

9. Guaranteed by characterization, not production tested.

## Capacitance

Symbol	Parameter	V <sub>AUDIO</sub> / V <sub>BUS</sub> (V)	Condition	T <sub>A</sub> =-40°C to +85°C			Unit
				Min.	Typ.	Max.	
C <sub>IN (ASEL)</sub>	Control Pin Input Capacitance (A <sub>SEL</sub> )	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V	V <sub>Bias</sub> =0.2V		2.5		pF
C <sub>COND(+R, D-/L)</sub>	D+/R, D-/L (Common Port) On Capacitance	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V A <sub>SEL</sub> =0V (C <sub>ONUSB</sub> )	V <sub>Bias</sub> =0.2V, f=6MHz Figure 26		25		pF
		V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V A <sub>SEL</sub> =2.7V (C <sub>ONAudio</sub> )	V <sub>Bias</sub> =0.2V, f=6MHz Figure 26		29		
C <sub>OFF(D+, D-)</sub>	USB Input Source Off Capacitance	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V A <sub>SEL</sub> =2.7V	f=6MHz, Figure 25		5		pF
C <sub>OFF(R/L)</sub>	Audio Input Source Off Capacitance	V <sub>AUDIO</sub> =2.7V V <sub>BUS</sub> =4.25V A <sub>SEL</sub> =0V	f=6MHz, Figure 25		17		pF

Typical Characteristics

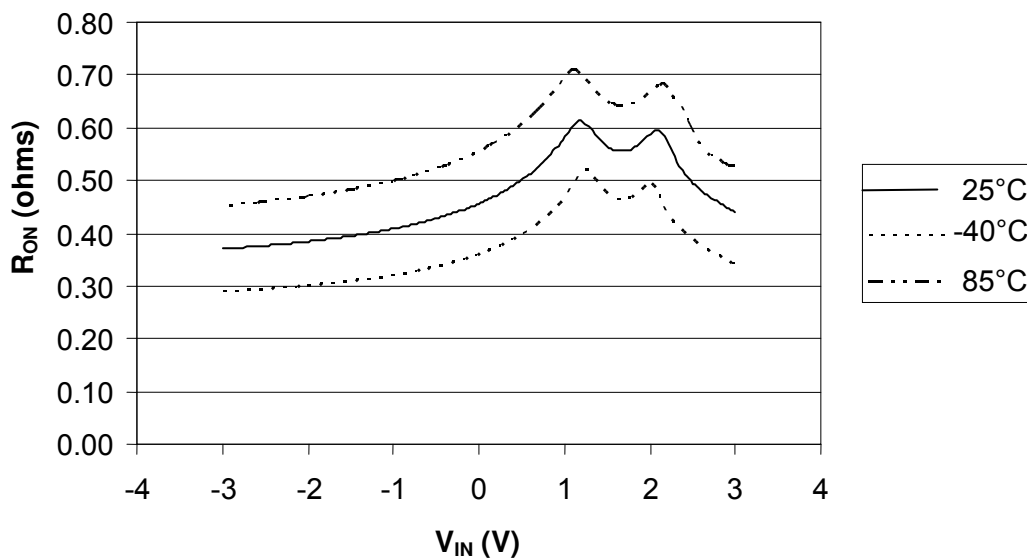


Figure 5. RON Audio Characterization (RON Audio R, V<sub>AUDIO</sub>=2.7V)

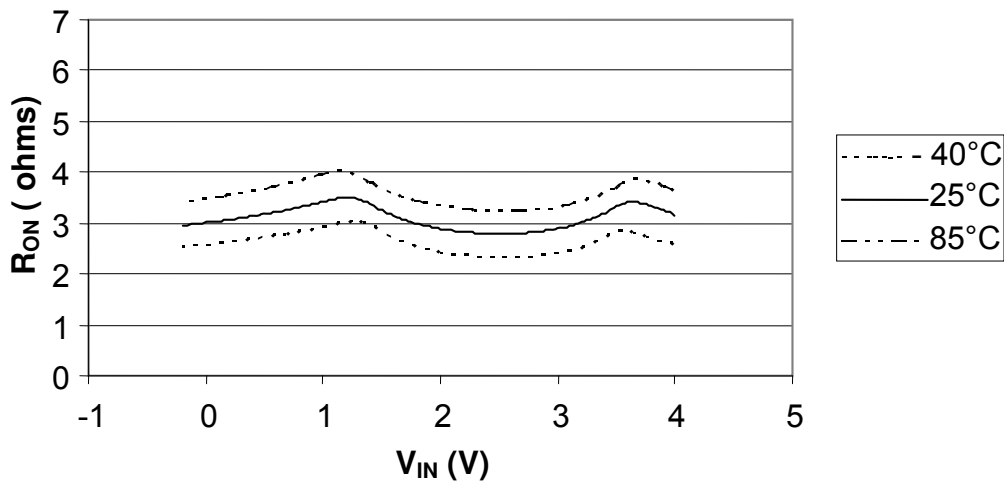


Figure 6. RON USB Characterization (RON USB D+)

Typical Characteristics (Continued)

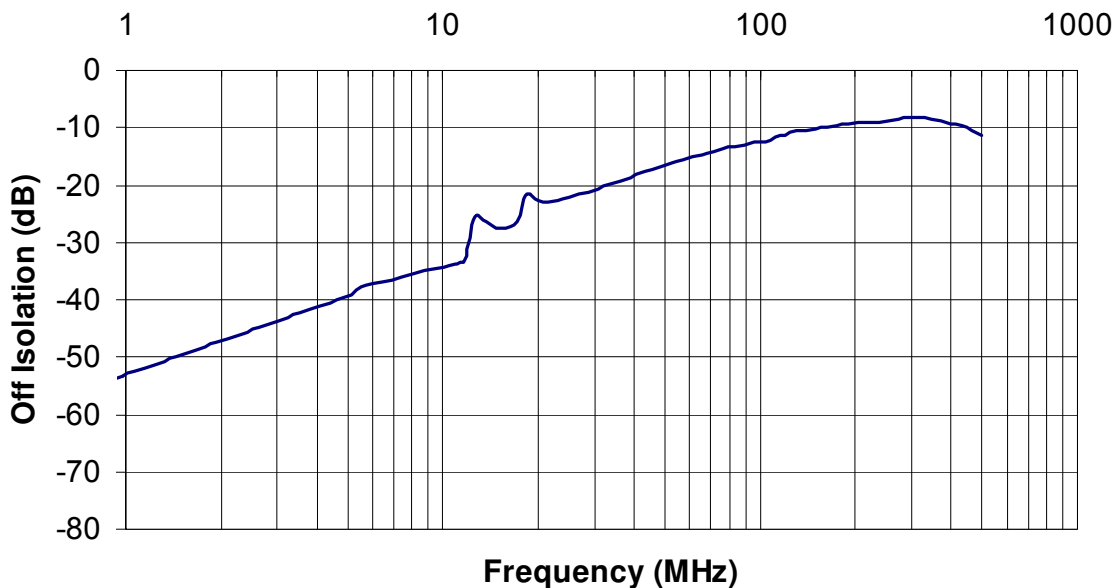


Figure 7. Off-Isolation (Audio) Characterization, Frequency Response at  $V_{CC} (V_{AUDIO})=2.7V$

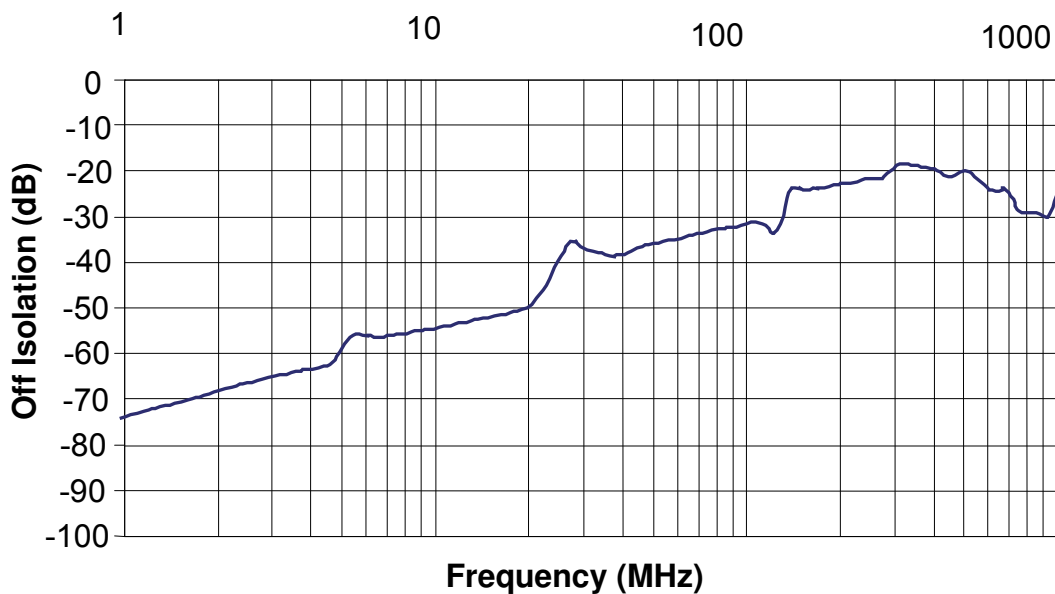
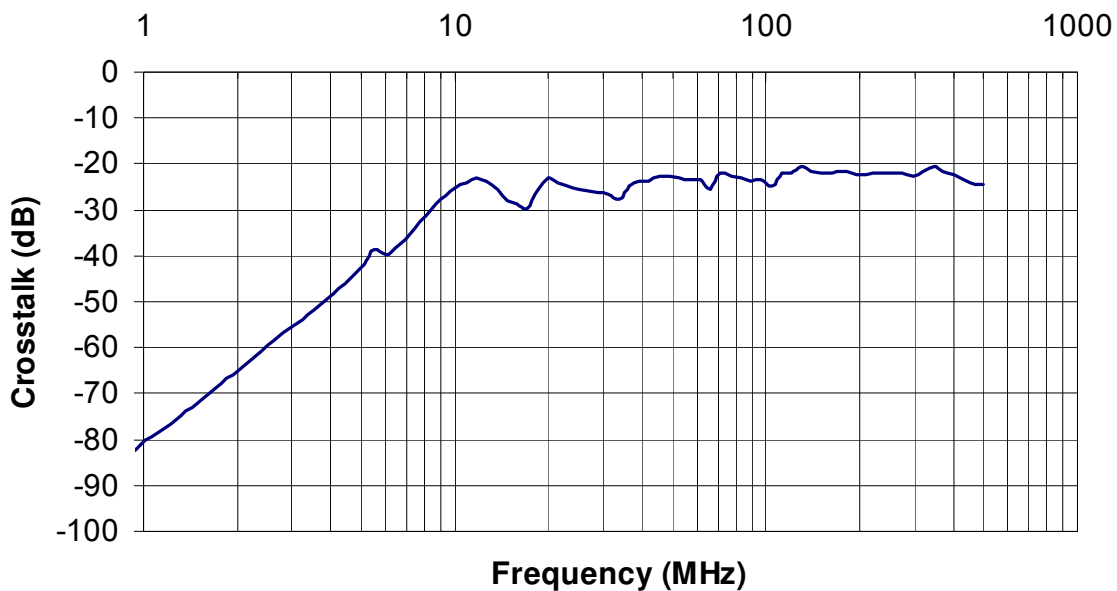
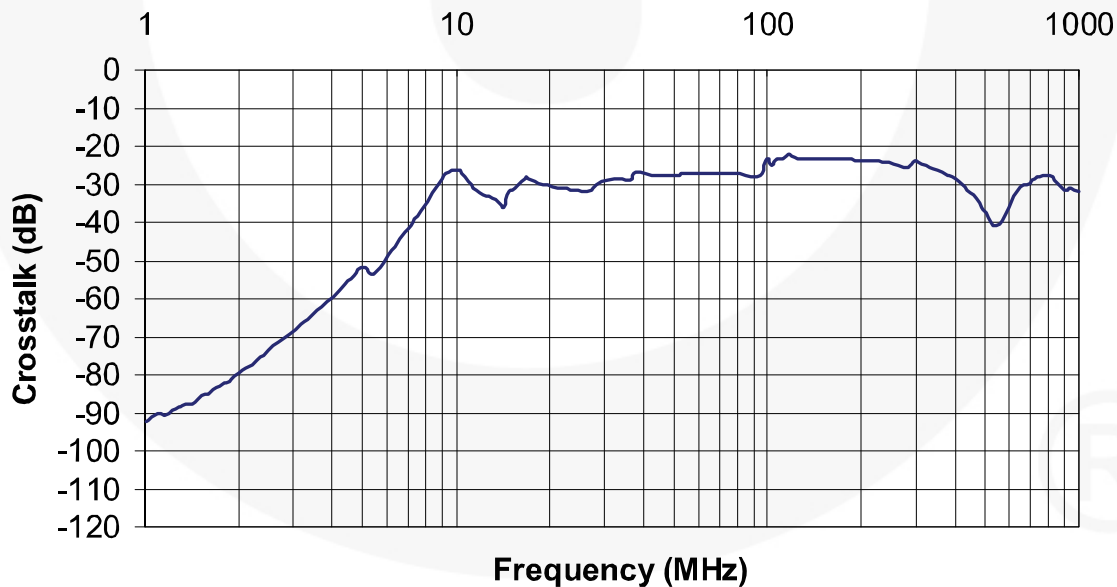


Figure 8. Off-Isolation (USB) Characterization, Frequency Response at  $V_{CC} (V_{BUS})=4.25V$

**Typical Characteristics** (Continued)



**Figure 9. Non-Adjacent Channel Crosstalk (Audio) Characterization at  $V_{CC} (V_{AUDIO})=2.7V$**



**Figure 10. Non-Adjacent Channel Crosstalk (USB) Characterization at  $V_{CC} (V_{BUS})=4.25V$**

Typical Characteristics (Continued)

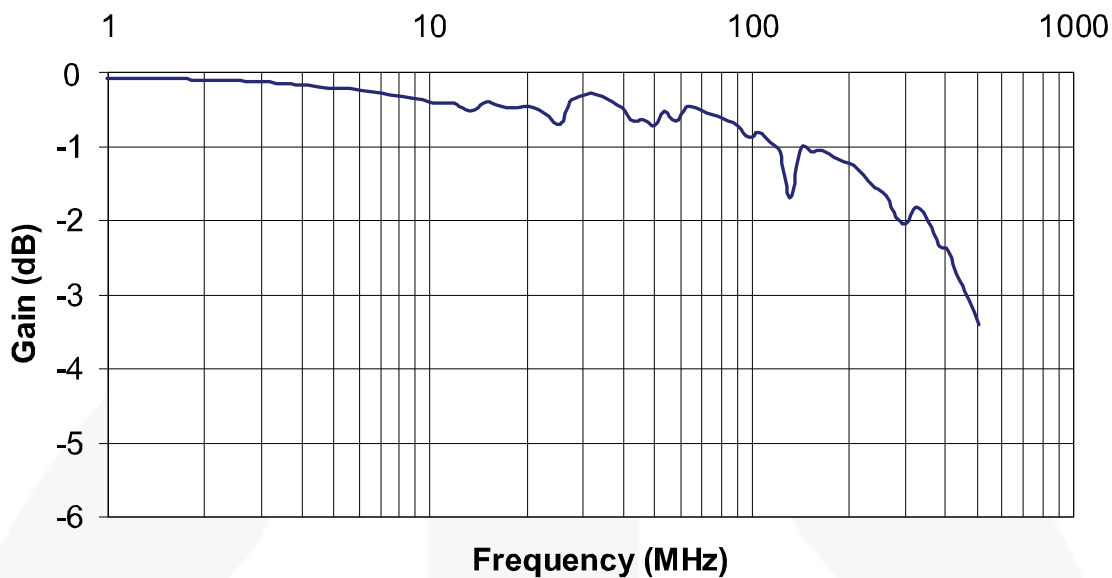


Figure 11. Bandwidth Characterization, Frequency Response at  $C_L=0pF$ ,  $V_{CC} (V_{AUDIO})=2.7V$

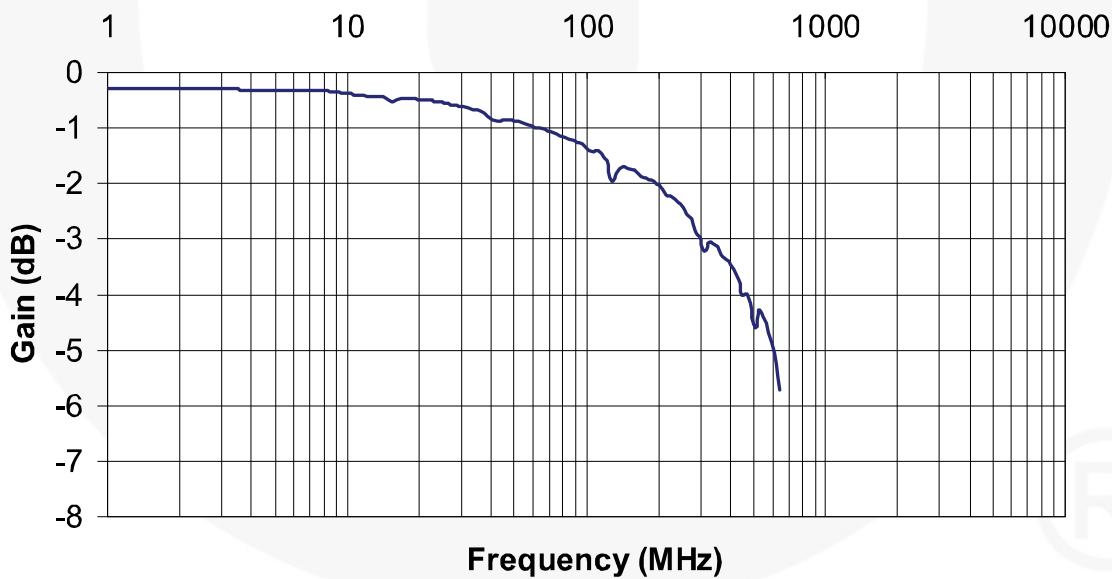
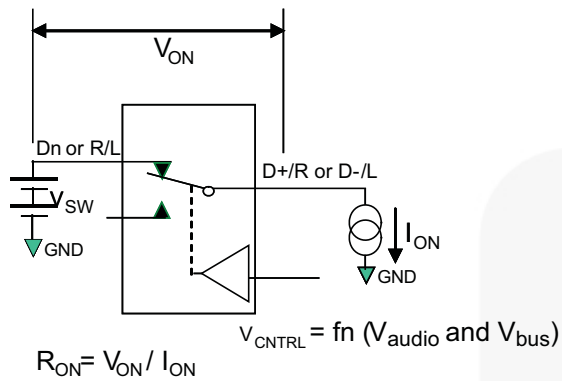
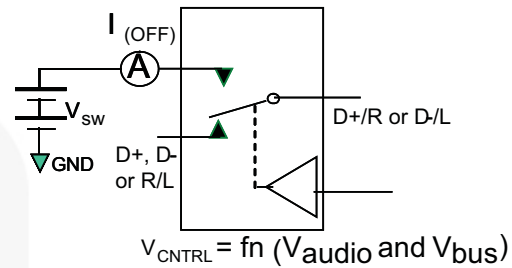


Figure 12. Bandwidth Characterization, Frequency Response at  $C_L=0pF$ ,  $V_{CC} (V_{BUS})=4.25V$

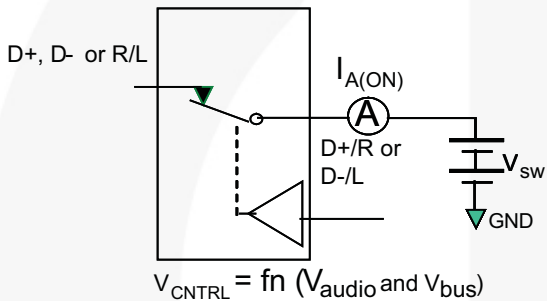
### Test Diagrams



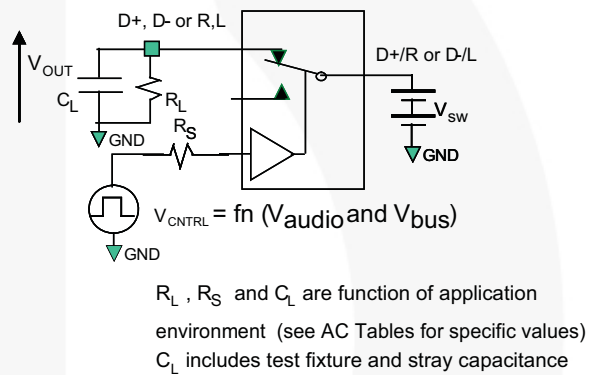
**Figure 13. On Resistance**



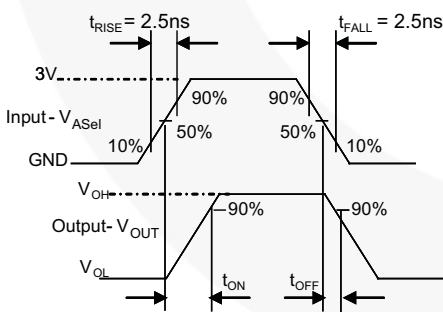
**Figure 14. Off Leakage**



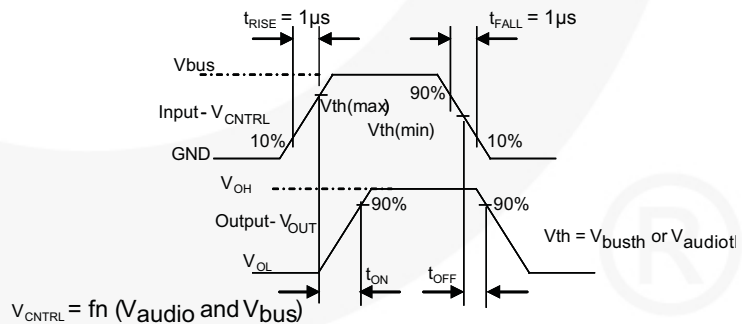
**Figure 15. On Leakage**



**Figure 16. AC Test Circuit Load**

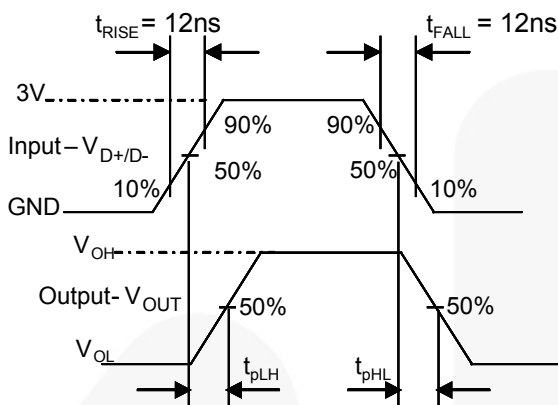


**Figure 17. Turn-On / Turn-Off Waveforms ( $A_{SEL}$ )**

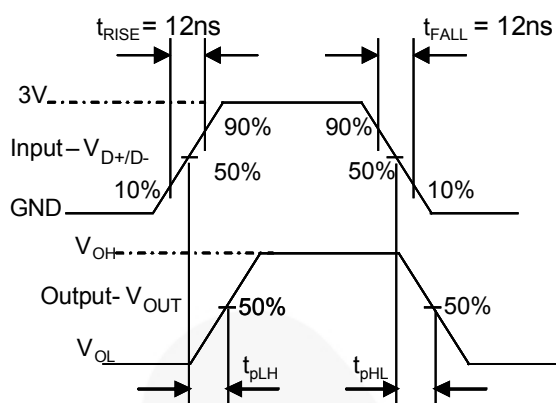


**Figure 18. Turn-On / Turn-Off Waveforms (USB/Audio)**

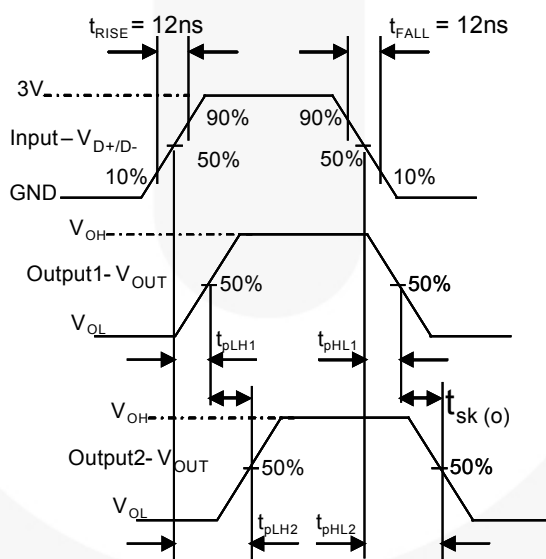
**Test Diagrams** (Continued)



**Figure 19. USB Switch Propagation Delay Waveforms**

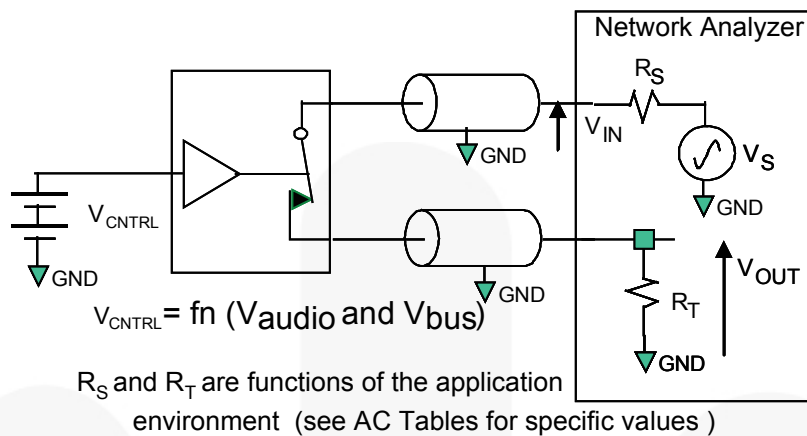


**Figure 20. Pulse Skew:  $t_{SK(P)} = |t_{pHL} - t_{pLH}|$**

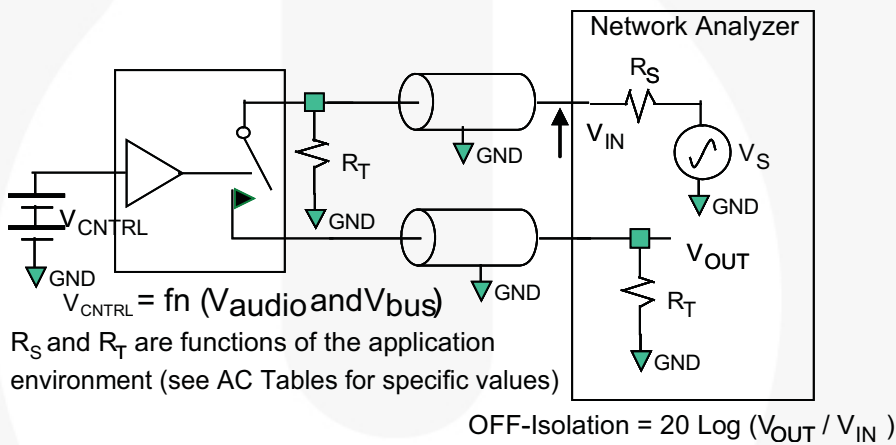


**Figure 21. Output Skew:  $t_{SK(O)} = |t_{pLH1} - t_{pLH2}|$  OR  $|t_{pHL1} - t_{pHL2}|$**

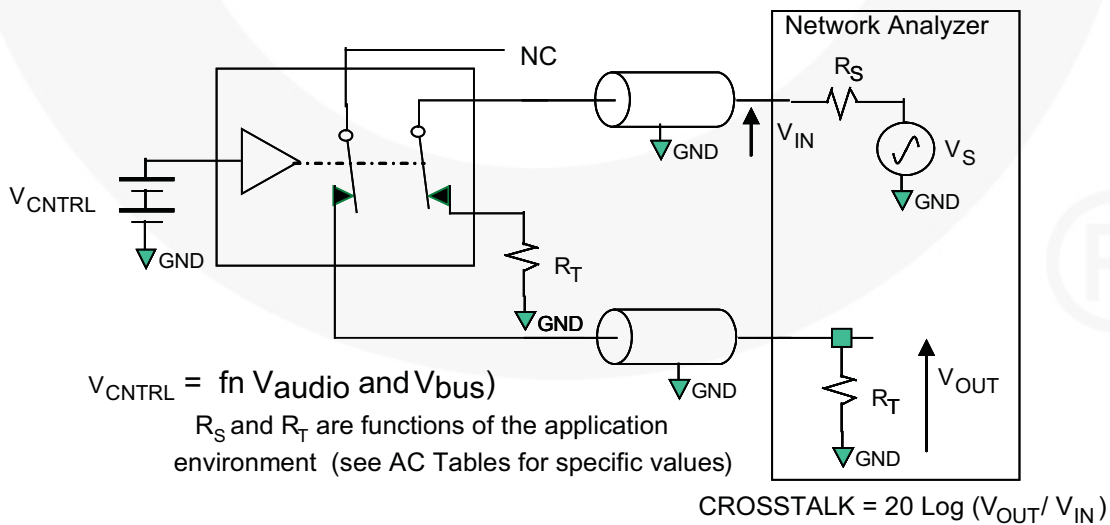
**Test Diagrams** (Continued)



**Figure 22. USB Bandwidth**



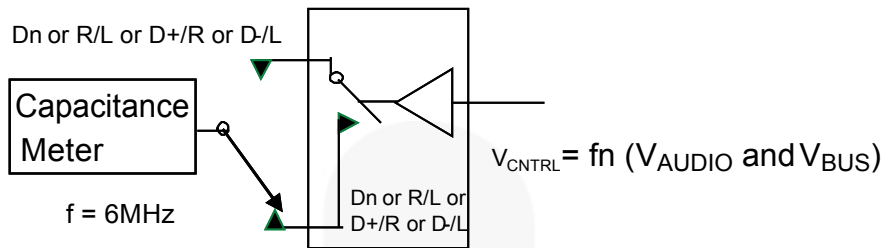
**Figure 23. Channel Off Isolation**



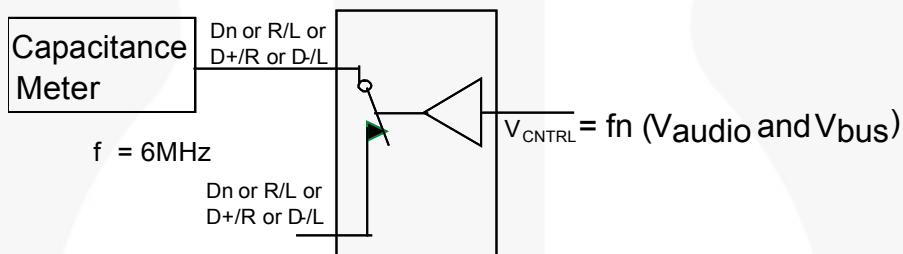
**Figure 24. Non-Adjacent Channel-to-Channel Crosstalk**



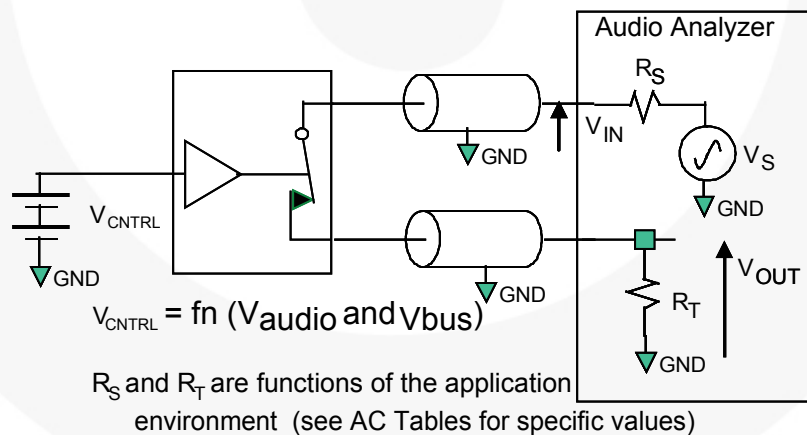
**Test Diagrams** (Continued)



**Figure 25. Channel Off Capacitance**



**Figure 26. Channel On Capacitance**



**Figure 27. Total Harmonic Distortion**

## Physical Dimensions

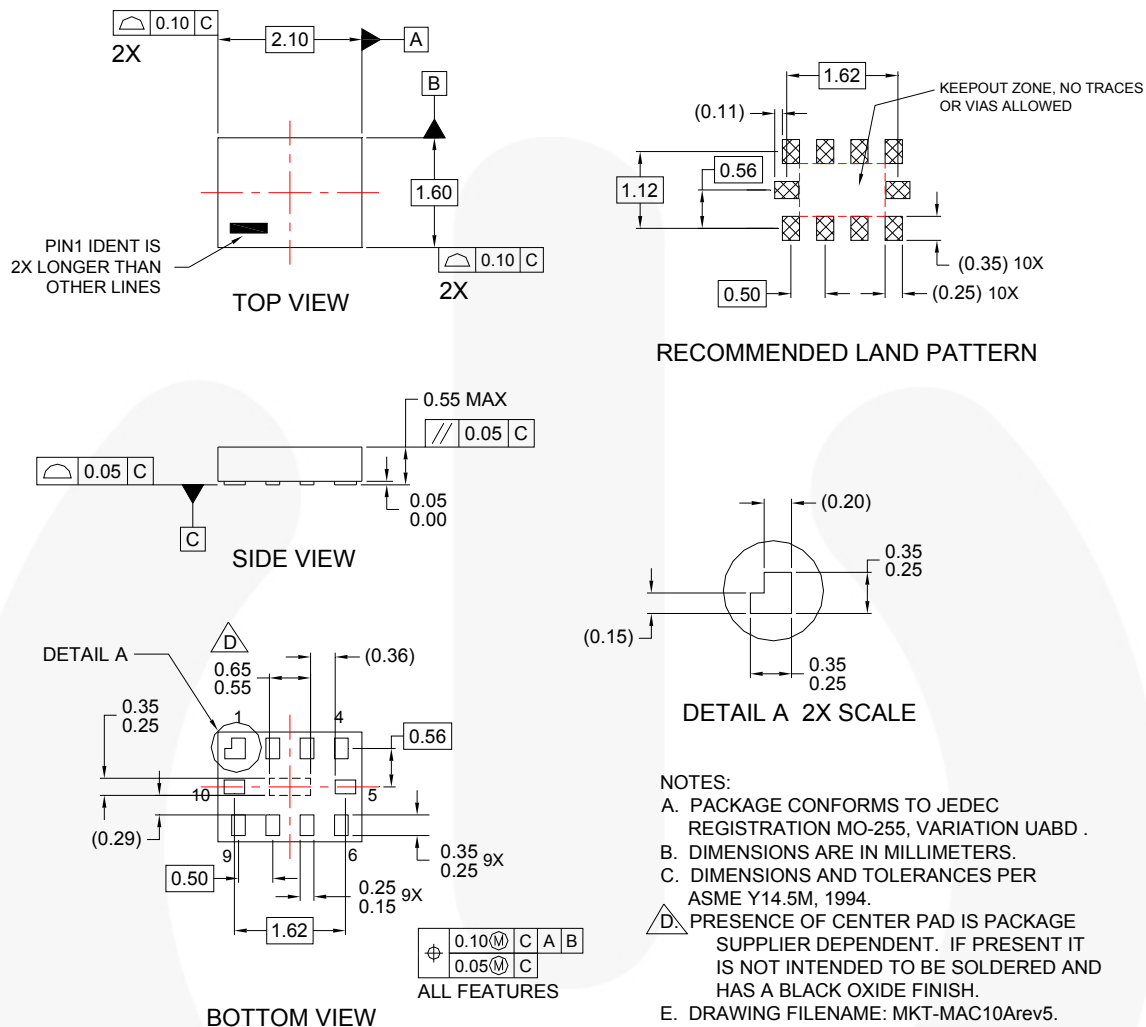


Figure 28. 10-Lead MicroPak™

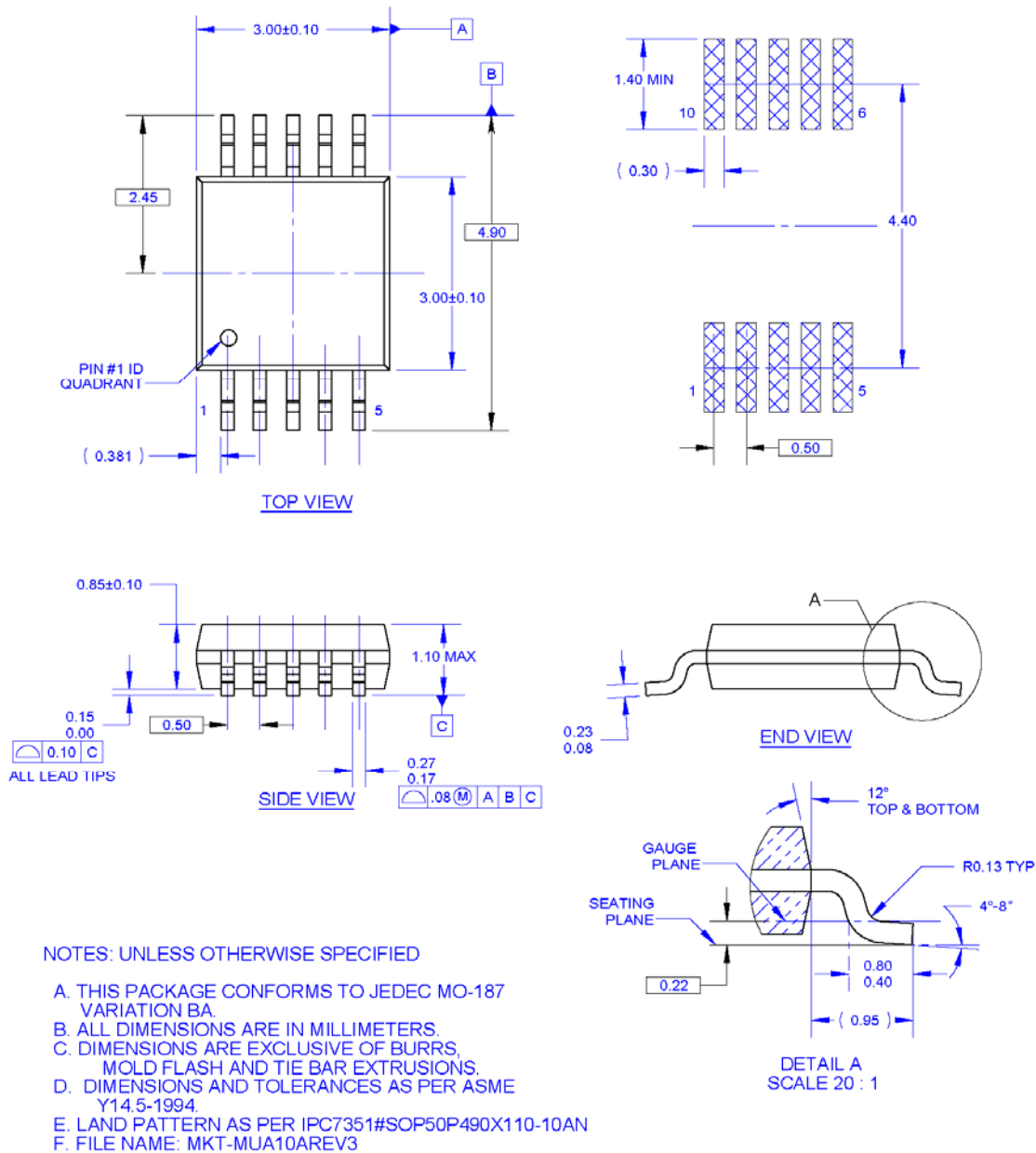
Package Designator	Tape Section	Number Cavity	Cavity Status	Cover Tape Status
L10X	Leader (Start End)	125 (typical)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typical)	Empty	Sealed

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## Physical Dimensions



**Figure 29. 10-Lead Molded Small Outline Package (MSOP)**

Tape Size	A	B	C	D	N	W1	W2	W3
	13	0.059	0.512	0.795	7.008	0.448	0.724	0.486-0.606
(12mm)	(330)	(1.5)	(13)	(20.2)	(178)	(12.4)	(18.4)	(11.9-15.4)

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